Performance of a none-isochronous position-sensitive detector for the Rare-RI Ring

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We have developed a large area position-sensitive detector with a thin foil to be used for mass measurement with the Rare-RI Ring.[1)] The principle of the detector operation is shown in the bottom of Fig. 1. When high energy beam passes through the thin foil, secondary electrons (SEs) are released and reflected by the outer and inner mirror grids potential. The SEs energy is determined by the acceleration grid placed after the foil. The beam position is inferred from SEs position measurement with the delay line MCP placed 45° from the foil. To minimize the effect of the SEs initial velocity, the detector has an isochronous design,[2)] which is achieved by careful choice of geometry and potentials: $D/(L_1 + L_2) = 0.236U_{mir}/U_{acc}$, where U_{mir} and U_{acc} are the acceleration and mirror potentials, respectively, D, L_1 and L_2 are dimensions of detector as shown in Fig. 1. We have designed the detector to be operated in the isochronous condition and also in the none-isochronous condition, simply by modifying the distance D between the inner and outer mirror grid. In the isochronous detector operation $D = 28$ mm, while for the none-isochronous operation $D = 8$ mm.

We have tested the detector at HIMAC with 200 MeV/nucleon ^{84}Kr beam in both isochronous (Iso) and none-isochronous (None-Iso) operation. For the Iso detector we tested the performance for a grid pitch of 1 mm, while for the None-Iso detector 1 mm and 2 mm pitch were tested. The test results are summarized in Table 1. The detector position accuracy is determined by the deviation from the foil image reconstructed by two PPACs. The position resolution is determined from a 2 mm diameter gate on the reconstructed foil image. For the mass measurement with the Rare-RI Ring the accuracy and resolution of the horizontal position are critical. The horizontal resolution of the None-Iso is better than the Iso detector. The position accuracy of the None-Iso detector with 2 mm grid pitch is best, because we introduced a calibration mask in front of the foil to correct for any misalignment between the PPACs and the detector that could result in a compromised position accuracy.

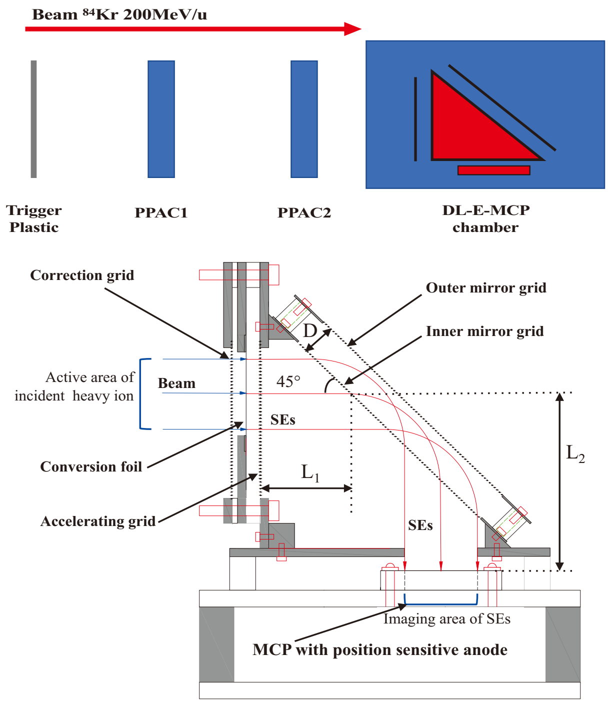

Fig. 1. (Top) Experimental setup at HIMAC consisting of a trigger plastic scintillator, two PPACs and a vacuum chamber containing the DL-E-MCP. (Bottom) Side view of the DL-E-MCP detector, where the beam passage through the foil generates secondary electrons that are reflected to the MCP with position-sensitive delay line anode.

Table 1. The detector position accuracy $A_{x,y}$ and resolution in sigma ($\sigma_{x,y}$) are shown for both horizontal (x) and vertical (y) beam positions for different detector operation; Isochronous (Iso.) and none-isochronous (None-Iso.). The performance of the latter is shown for two different grid pitch of 1 mm and 2 mm. The results are shown for the same acceleration potential and different optimized mirror potential in each configuration.

	Iso. 1 mm pitch	None-Iso. 1 mm pitch	None-Iso. 2 mm pitch
A_x [mm]	+4.0	+1.5	−0.8
A_y [mm]	−0.1	0.0	+0.6
σ_x [mm]	3.5	2.4	2.9
σ_y [mm]	2.2	2.9	4.5

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